한국동물분류학회지 제7권 제2호
The Korean Journal of Systematic Zoology
Vol. 7, No. 2: 257-264 (December 1, 1991)

The First Zoeal Stage of *Pinnotheres sinensis* SHEN, 1932 (CRUSTACEA, BRACHYURA, PINNOTHERIDAE) Reared in the Laboratory

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굴속살이게(갑각강 • 게아목 • 속살이게과)의 제1 조에아 유생

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적 요

바지락에 공생하는 굴속살이게의 제1 조에아 유생에서 그 형태적 특징을 기술 및 도시하였다. 본종은 액극 • 배극 • 측극이 없고 제1소악과 제2소악의 내지가 각각 0.4, 1.2(3)의 강모를 제2악각의 내지가 2분절로 0.4의 강모를 가져 속살이게속의 유생특징을 잘 나타내고 있다. 그러나 제1 • 2소악의 저절 • 기절 강모수가 이미 보고된 Muraoka와 Konishi(1977), Konishi(1983)의 것과 다를 뿐만아니라 숙주도 *Mytilus* 속이 아닌 *Tapes*이므로 한국산 바지락내에 공생하는 굴속살이게의 상세한 기재가 요청된다.

Key words: Zoeal stage, Brachyura, *Pinnotheres sinensis*, Korea.

INTRODUCTION

Studies of brachyuran larvae provide information on systematic relations of families, genera or species (Rice, 1975) and facilitate identification of larvae in plankton (Bookhout and Costlow, 1979; Prasad and Tampi, 1957). Therefore, many papers about the crab larvae were made on the basis of laboratory-reared larvae.

The Pinnotheridae which as adults are mainly specialized commensals of molluscs or of a variety of other invertebrates contains six genera and nine species in Korea and three species (*P. sinensis*, *P. cyclinus*

and *P. pholadis*) belong to the genus *Pinnotheres* (Kim, 1973, 1982). *P. sinensis* is generally symbiotic with bivalved shells of shallow waters and ranges to nothern China, Korea and Japan (Sakai, 1976). The first zoea of Japanese species was described by Muraoka and Konishi (1977) and later by Konishi (1983) which was found in the plankton. Both authors collected the adult crabs living with *Mytilus edulis* and *M. coruscus*. This paper provides a detailed morphological description of the first zoea of *P. sinensis* in order to facilitate the identification of other species zoeas which may co-occur in the plankton and examine the classification of crab on the basis of larval features.

MATERIALS AND METHODS

In August, 1991, ovigerous crabs of *Pinnotheres sinensis* were bought from the market of Jagalchi, Pusan, Korea. They were symbiotic with *Tapes sp.* In the laboratory, they were placed in a sand bottom aquarium at 33.3‰ salinity and a temperature of 25°C in order to obtain larvae. As the larvae hatched, some of them were fixed immediately. Larvae showing the greatest activity were reared. Unfortunately only the first zoeal stage was obtained.

Specimens were preserved in 10% neutral formalin to check setation of appendages and were dissected in 70% alcohol-30% glycerine solution. Drawings were made with the help of a camera lucida and measurements were based on the mean of ten specimens. The carapace length of the zoea was measured from the base of the zoeal rostrum between the eyes of posterior margin of the carapace. The decapod larval terminology used throughout this paper closely follows the nomenclature by Goy et al. (1981).

RESULTS

Size. Carapace length 0.43-0.45mm (mean 0.44mm).

Carapace (Fig. A). No spines at all. Cardiac region with a pair of minute simple setae. Eyes sessile.

Antennule (Fig. B). With two aesthetascs and a small simple seta.

Antenna (Fig. C). Reduced as a small seta.

Mandibles (Fig. D). Asymmetrical. Molar process irregularly dentate: join margin of right molar process and incisor process with two teeth.

Maxillule (Fig. E). Endopodite two-segmented with four terminal plumodenticulate setae. Basal endite with five plumodenticulate setae and two small spine. Coxal endite with six plumodenticulate setae.

Maxilla (Fig. F). Endopodite two-lobed: upper lobe with two plumodenticulate setae, lower with a plumodenticulate seta. Basal and coxal endites with nine and six plumodenticulate setae, respectively. Scaphognathite bearing four marginal plumose setae and a terminal plumose process.

First maxilliped (Figs A,G). Basipodite with nine plumodenticulate setae, progressing distally 2,2,3 and 3. Endopodite five-segmented with 2,2,1,2 and 4 + 1 plumodenticulate setae, progressing distally. Exopodite with four plumose natatory setae.

Second maxilliped (Figs. A,H). Basipodite with four plumodenticulate setae. Endopodite two-segmented with 0,1 plumodenticulate setae, progressing distally. Exopodite with four plumose natatory setae.

Abdomen (Figs A,I). Composed of five somites widening to telson: somites two and three with dorsolateral processes in form of slight ridge-like swellings. Postero-dorsal border of somites two to five with a pair of small simple setae.

Telson (Figs A,I). Widening: rounded median lobe protruding beyond acute lateral lobes, three plumoden-

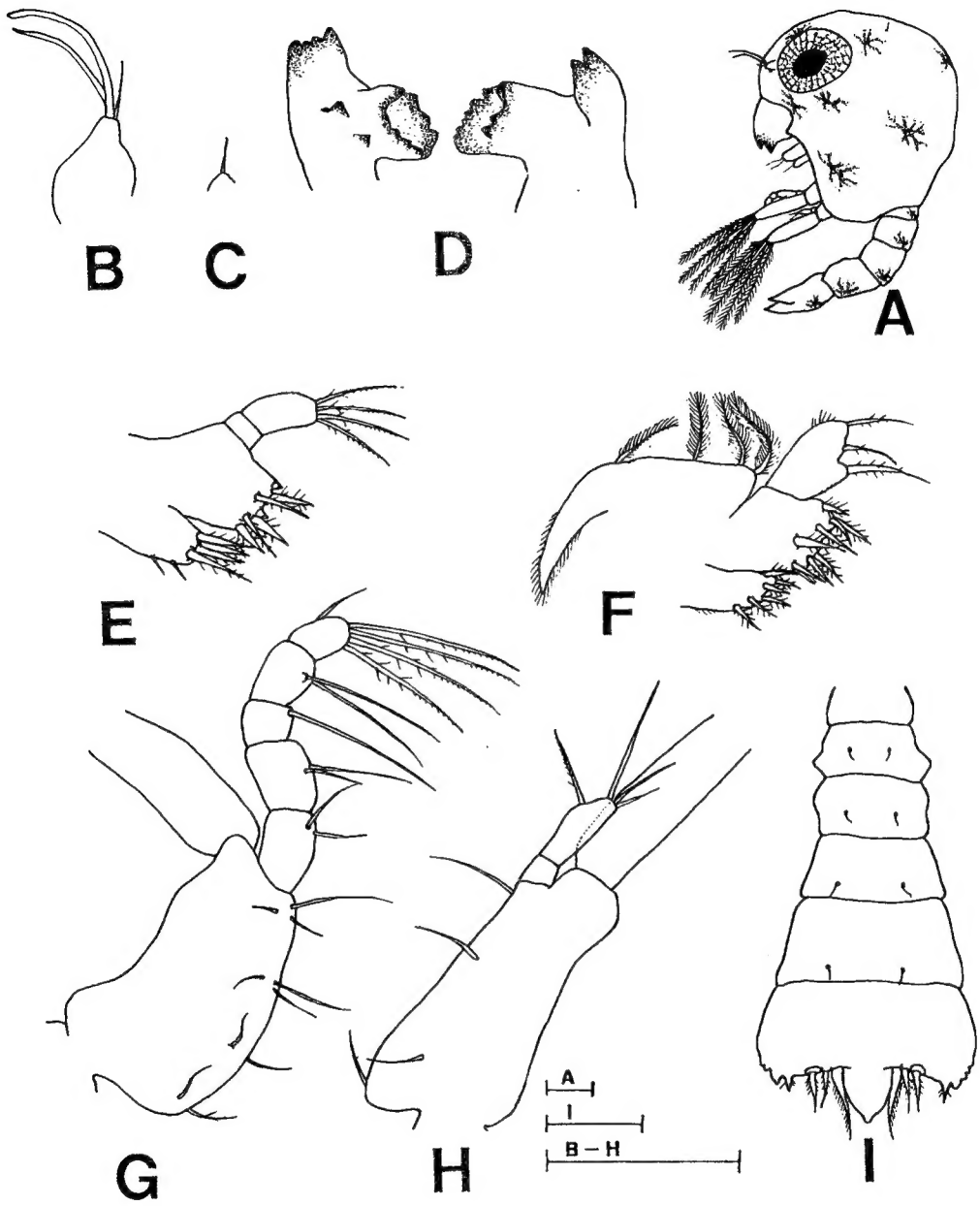

Fig. *Pinnotheres sinensis*, first zoeal stage: A, lateral view; B, antennule; C, antenna; D, mandibles; E, maxillule; F, maxilla; G, protopodite and endopodite of first maxilliped; H, protopodite and endopodite of second maxilliped; I, dorsal view of abdomen and telson. Scale bars = 0.1 mm.

ticulate setae between median and lateral lobes on each side.

Chromatophores (Fig. A) show the pattern of mixed dominant brown series: dark brown near to black or mild brown and yellow or red spots. The majority of dark brown series occur on the base of labrum and mandible, ventral to eye, behind eye, between eyes, posterior and dorsal to carapace, each abdominal somite and telson.

DISCUSSION

Rice (1975) could somewhat clearly classify brachyuran zoeae at the generic level by using the setation of the endopodite of the maxillule, maxilla and second maxilliped, the type of the antenna and the presence or absence of the lateral carapace spines. For example, in the family Pinnotheridae, the antenna was absent or reduced as a seta (the genus *Pinnotheres*) (Rice, 1975; Muraoka and Konishi, 1977; Costlow and Bookhout, 1966; Robert, 1975; Konishi, 1983; Sandoz & Hopkins, 1947; Hashimi, 1969; Hart, 1935), only a spinous process (the genus *Dissodactylus*) (Pohl and Telford, 1981, 1983; Pohl, 1984) and a spinous process with a seta (the genera *Pinnaxodes* and *Pinnixa*) (Hong, 1974; Sekiguchi, 1978).

Also, Rice (1980) reported that all pinnotherid zoeae had the unique combination of a vestigial or absent antennal exopodite, an unarmed basal segment of the endopodite of the maxillule, an endopodite of the maxilla with only three setae, and a two-segmented endopodite on the second maxilliped which proximal segment being unarmed. According to the features of the present material, the first zoea of *P. sinensis* showed the characteristics which were correspond well with those of pinnotherid zoeae.

Other characteristics, such as the setations of the basal and coxal endites of the maxillule and maxilla, could be used to classify zoeae at the level of species as shown in Table 1. Also, in Table 2, I could find that the only difference among the subspecies of *Scopimera globosa* or the subspecies of *Helice tridens* was the setations of the basal and coxal endites of the maxillule and maxilla. Futhermore, there were two or three common number of seta among the group of subspecies. But, in the *P. sinensis*, the present material had one common number of seta, which was compared with those of Konishi's material (larvae taken in plankton) and no common with those of Muraoka and Konishi's material (laboratory-reared larvae). Thus I thought that the Korean zoea was at least different from the Japanese zoea above the subspecific level.

Table 1. Distinguishable characteristics of the setations of the basal and coxal endites of the maxillule and maxilla in described *Pinnotheres*.

	Maxillule		Maxilla		Source
	bas.	cox.	bas.	cox.	
Pinnotheres pisum	6	3	8	5	Rice, 1975
Pinnotheres boninensis	5	4	8	5	Muraoka, 1977
Pinnotheres pholadis	5+1	4	9	5	Konishi, 1983
Pinnotheres ostreum	5+1	4	8-9	5	Sandoz & Hopkins, 1947
Pinnotheres placunae	5	3	7	5	Hashimi, 1969
Pinnotheres taylori	5	5	6	?	Hart, 1935
Pinnotheres chamae	5	4	9	6	Roberts, 1975
Pinnotheres maculatus	5	4	9	4	Costlow & Bookhout, 1966
Pinnotheres sinensis	5+2	6	9	6	Present paper

*bas. = basal endite, cox. = coxal endite.

Table 2. Comparison of the setations of the basal and coxal endites of the maxillule and maxilla in described some subspecies zoeae.

	Maxillule		Maxilla		Source
	bas.	cox.	bas.	cox.	
OCYPODIDAE					
Scopimera globosa	5	4	7	5	Terada, 1976
Scopimera globosa longidactyla	5+1	4	9	5	Jang & Kim, 1989
GRAPSIDAE					
Helice tridens sheni	5	5	9	7	Kim & Ko, 1982
Helice tridens wuana	5	4	8	5	Baba & Moriyama, 1972
Helice tridens tridens	5	4	6	5	Baba & Moriyama, 1972
Helice tridens tientsinensis	5	4	8	6	Kim & Park, 1983
PINNOTHERIDAE					
Pinnotheres sinensis	5	4	8	5	Muraoka & Konishi, 1977
Pinnotheres sinensis	5+1	4	8	6	Konishi, 1983
Pinnotheres sinensis	5+2	6	9	6	Present paper

Table 3. Comparison of some informations about the adult female crab of *P. sinensis*.

Source	Carapace Width (CW)	Carapace Length (CL)	Ratio (CL/CW)	Host	No. (individual)
Kim, 1973	10.5mm	7.5mm	0.71	*Ostrea, Mytilus*	1
Sakai, 1976	17mm	12mm	0.71	*Ostrea, Paphia* *Mytilus, Volsella*	1
Present paper	8mm	5mm	0.63	*Tapes*	20

In Table 3, adult crab of *P. sinensis* symbiotic with *Tapes* showed remarkably small size of the carapace compared with Kim and Sakai's materials (Kim, 1973; Sakai, 1976). In addition to this, the color of the present material was pale green whereas crab living in *Mytilus* showed color of brownish white. So, it seemed to be needed a detailed description of the Korean crab of *P. sinensis* symbiotic with *Tapes* and a comparison with the Japanese crab symbiotic with *Mitylus*.

ABSTRACT

The first zoea of *Pinnotheres sinensis* showed the characteristics which were correspond well with those of *Pinnotheres* zoeae: no carapace spines, endopodites of maxillule and maxilla with 0.4, 1.2(3) setation and endopodite of second maxilliped with 0.4 setation. However,

the setations of the basal and coxal endites of the maxillule and maxilla was different from those of Muraoka and Konishi (1977), and Konishi (1983). The host of adult crab was *Tapes*, not *Mytilus*. Thus, there was a need for detailed description of the Korean crab of *Pinnotheres sinensis* symbiotic with *Tapes*.

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RECEIVED: 16 OCTOBER 1991
ACCEPTED: 2 NOVEMBER 1991